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ABSTRACT

An experiment was conducted to ascertain the effectiveness of various attention-directing techniques in improving visual learning. One 1st and one 4th grade class from each of four elementary schools in Cedar Falls, Iowa were each divided into four treatment groups. Four cueing methods--a large arrow, a small arrow, a pointer, plus a control without visual indicators--were used with four different sets of line drawings. All treatment-drawing combinations were administered to each group through overhead projector transparencies. The pictures were presented with accompanying audiotaped information identifying each of the drawings and providing a description of one specific part of a drawing. After hearing the audio descriptions and observing the pictures and orienting arrows and pointers, subjects marked the indicated parts of corresponding drawings on their response sheets. Fourth graders did so well on the task that there was little variation in the treatment means. For the first graders, a significant difference in methods was found. In order of effectiveness the treatments were the pointer, the large and small arrows, then the auditory cueing alone. The line drawings were rank ordered by the level of difficulty they presented to respondents. A significant interaction of cueing methods and drawings was noted. (KB)

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A STUDY OF THE EFFECTIVENESS OF THREE VISUAL ATTENTION-DIRECTING DEVICES ON THE RECALL OF RELEVANT INFORMATION FROM LINE DRAWINGS

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INTRODUCTION

In the teaching-learning process, still pictures are used to provide instruction and to complement and/or supplement auditory or print information. A problem in using still pictures is in being assured that students extract pertinent information. The student may have difficulty in locating and responding to relevant visual information, and the teacher has little assurance that the student is attending to the desired portion of the picture.

Teachers should be able to effectively use pictorial information so that they can aid their students' learning. Many pictures contain more information than is necessary for the task at hand, and students must be guided in interpreting extraneous and/or ambiguous pictorial information.

Exactly what effects various attention-directing techniques have on learning from pictures is not well known. Brown, Lewis, and Harcleroad (1973) summarized the implications of the research when they stated that verbal and/or symbolic cueing of important information in still pictures through the use of arrows or other marks can clarify (or, possibly change) the message intended to be communicated by them.

In order to learn, a child must be able to attend to relevant stimuli, to select those stimuli which pertain to a particular situation, and to organize incoming stimuli in order to respond appropriately. Young children are less capable than adults of shutting out extraneous stimuli (Maccoby and Hagen, 1965). Being able to focus attention selectively is of importance and interest since a child's learning depends heavily on skills in identifying task-relevant information.

Mackworth and Bruner (1970) point out that developmental trends in the ability to direct attention are only beginning to be understood. Fleming (1970) and Bateman (1971) suggest that two of the first problems of a teacher or any message designer are to gain the attention of the audience and to direct this attention to the relevant information. Kennedy (1971) notes that current textbooks use a variety of orienting cues or "signalling devices" to alert the student to important information. Cueing devices often used in textbooks are italicized words, colored or bold-faced type, brackets, and colored boxes or frames. Kennedy believes that pupils frequently overlook or ignore such cueing devices.

In an article on instructional television, Anderson (1972) suggests using arrows as an effective method in directing a viewer's attention to relevant material. The arrows should function to minimize the effect of irrelevant or possibly distracting material presented on the television screen.

Evidence for the effectiveness of cueing devices for calling attention to important visual information is found in a film study by Lumsdaine, Sulzer, and Kopstein (1969). Using a film on how to read a micrometer, they found that animation devices such as pop-in labels and moving arrows produced a marked increase in the amount of learning from the film.

In a summary of his studies on methods of cueing televised instruction, Dwyer (1972) indicated that students learn best when they are involved in looking and listening for specific information in an instructional presentation, rather than merely looking and listening. It was Fleming's (1970) opinion that pointers or orienters such as words and arrows can facilitate the selection of the relevant aspects of an instructional presentation.

Miller (1938) found that in order for children to see key items in a picture, the teacher had to point them out.

Studies of eye movements of adults who looked at pictures indicated that directions given prior to looking at a picture have marked influence upon what was seen in the picture (Buswell, 1935). Brandt (1953) suggested that initial fixations of the viewer's eyes tended to fall to the left and above center of the picture. This probably occurred because in reading training, the reader is conditioned to first look in the upper left-hand quadrant of a page.

Travers (1969) conducted a picture perception study with children ranging in age from four to twelve years old. The study demonstrated a tendency for young children to notice one particular object in a picture and the failure to observe or mention other objects in the same picture.

Purpose

This experiment was designed to provide answers to the following questions: Is a visual attention-directing device, such as an arrow or pointer, more effective than oral instructions alone in aiding students to locate and respond to a specific part of a picture? Are there any differences in effectiveness between using a large arrow, a smaller arrow, or a pointer as an attention-directing device used to complement oral instructions in aiding students to locate and respond to a specific part of a picture? Are there any differences in the effectiveness of these attention-directing devices in aiding students to locate and respond to a specific part of a picture?

METHODOLOGY

Subjects

The Subjects (Ss) participating in the study were 128 first graders and 104 fourth graders from four elementary schools in Cedar Falls, Iowa.

TABLE 1

SCHOOLS, CLASSES, AND SUBJECTS PARTICIPATING IN THE EXPERIMENT

		Class Composition			
School	Grade	Male	Female	N (By Grade)	
Lincoln	1	14	10	24	
	4	15	29		44
Main Street	1	15	13	28	
	4	0	0		0
Malcolm Price Laboratory	1	15	21	36	
	4	0	0		0
Orchard Hill	1	28	12	40	
	4	33	27		60
TOTALS		120	112	128	104

Design and Treatments

The following null hypotheses were tested with both first and fourth grade subjects:

1. There is no significant difference in Ss' ability to extract relevant information from line drawings whether cued by orienting arrows, a pointer, or given no visual orienting cue.

2. There is no significant difference in Ss' ability to extract relevant information from line drawings containing orienting arrows as compared to line drawings containing no visual orienting cue.

3. When arrows are used as orienting cues, the size of the arrow will have no significant effect on Ss' ability to extract relevant information from line drawings.

4. There is no significant difference in Ss' ability to extract relevant information from line drawings when a pointer is used to direct attention as compared to line drawings when no visual orienting cue is used.

5. There is no significant difference in Ss' ability to extract relevant information from line drawings containing orienting arrows and from line drawings when a pointer is used to direct attention.

The four treatments evaluated were: a control auditory/visual stimulus package (AV); the auditory/visual stimulus package plus a large arrow (AVLA); the auditory/visual stimulus package plus a small arrow (AVSA); and, the auditory/visual stimulus package plus a pointer (AVP).

The statistical design required that the students in each class be separated into four equal groups. Four different cueing methods were used with four different line drawings, making up the treatments for a four-by-four Latin square. A mixed Type II design (Lindquist, 1953) allowed for the assignment of the various treatment combinations to each of the four groups of students from a class. The students of each class were randomly assigned to the groups. Extra students were randomly removed from groups and were not used in the final statistical analyses. The various treatment combinations given each group are illustrated in Figure 1.

Drawings (Order Constant)	Groups*			
	G1	G2	G3	G4
Fruit	T1**	T2	T3	T4
Dogs	T4	T1	T2	T3
Fish	T3	T4	T1	T2
Birds	T2	T3	T4	T1

*Groups (within a class)

**T1 = AV
T2 = AVLA
T3 = AVSA
T4 = AVP

Figure 1. Group Treatment Schedule for Presentation of Stimulus Materials

Materials

The four experimental treatments were administered through a set of four overhead transparencies with accompanying audio-taped information. All stimulus and response materials were designed by the author. Each transparency contained three conceptually similar line drawings. The drawings for each of the transparencies were (1) three fruit; (2) three dogs; (3) three fish; and, (4) three birds.

Black-line drawings were used to obtain good visual contrast for purposes of perception and identification by the subjects. The line drawings were used because they provided adequate information for recognition purposes.

The auditory information accompanying each of the transparencies identified each of the drawings on the transparency. The tape also contained information about a specific part of one particular drawing. The other two drawings on the page served as distractors. The visual stimulus transparencies and accompanying auditory information are shown in Appendix B.

The arrows and the pointer used to attempt to direct the subject's attention on the transparencies were operationally defined. The arrows consisted of a head or tip in the form of an equilateral triangle, and a shaft. The smaller arrow had an overall length of approximately one-half inch. Its head had a side dimension of one-eighth inch. The shaft was three-eighths inch long and one-sixteenth inch thick. The larger arrow was approximately twice the size of the smaller arrow. Its head had a side dimension of one-fourth inch and its shaft was three-fourths inch long with a thickness of one-eighth inch. The same style was used for both sizes of arrows. Line drawings for the transparencies and response booklets were made with a No. 2 Rapidograph pen. This resulted in the shaft of the smaller arrow being approximately four times as thick as the lines of the drawings. Examples of the arrows are found in Appendix D. A sharpened pencil was used as the pointer.

Response booklets containing drawings identical to those presented on the transparencies were prepared. Positions of drawings on each response booklet page were changed to prevent subjects from simply remembering the transparency and marking a corresponding position on the response page. A sample of the response booklet is shown in Appendix C.

Procedure

Subjects in each class were randomly assigned to one of four groups. Group sizes ranged from five to nine students, depending on the class size. Each group was then taken from the classroom to an area (empty classroom or hallway) where the experiment took place. The overhead projector was set up so that the projected image filled a forty-eight-inch wide screen area. Caution was taken to insure that all subjects could easily view the screen and hear instructions, yet were physically separated enough to discourage viewing of peer responses.

Subjects in the group were each given a sample response page of stimulus material consisting of line drawings of three familiar animals. Subjects were then shown an overhead transparency identical to their response page. Subjects were shown how verbal instructions, arrows, and pointing could be of assistance in locating specific visual information. After hearing instructions and observing the use of an orienting arrow and pointer, the subjects were requested to mark specific parts of each drawing on the page. This page was designed to determine each subject's ability to follow instructions and to carry out the eye-hand coordination task required for responding. After the subjects had made their responses, the sheets were collected. This response page and the accompanying auditory material is found in Appendix A.

The subjects then listened to general instructions about the experiment. Simultaneously with the viewing of the transparencies, the subjects heard information about each transparency, and what to specifically look for. The overhead projector was turned off after the studying of the four stimulus transparencies.

The subjects were then given response booklets containing drawings identical to those previously studied on the screen. After the subjects had opened their response booklets to the requested page, they were instructed to place a mark on a particular portion of a particular drawing. The part of the drawing the subjects were requested to locate and mark corresponded to the same portion of the particular drawing studied on the transparency. The time required to administer the experiment to each group was approximately ten minutes.

Criterion Measure

Data was tabulated on the basis of whether subjects did or did not mark the correct part of the specified drawing as they were instructed to do for each set of drawings in the response booklet. Since the specified parts of the drawings of two of the animals (dogs and birds) could not be absolutely defined, a guideline for the evaluator to use in determining correct placement of the responses was devised. A three-fourths inch diameter circle was placed over the area defined in the instruction. The subject's mark had to be within the circumference of the circle in order to be counted as a correct response.

RESULTS

Fourth Grade Ss

The scores of 104 fourth grade subjects and 128 first grade subjects were analyzed separately by grade level. An F statistic was calculated and checked for significance at the .05 level. Fourth grade Ss did so well on the test that there was little variation in the treatment means. This resulted in the failure to reject all null hypotheses for this grade level. The results of these analyses are shown in Tables 2 and 3.

TABLE 2

MEAN TREATMENT SCORES FOR FOURTH GRADE Ss

Cueing Methods	Drawings				
	Fruit	Dog	Fish	Bird	$\bar{X}$
AV	.92	.85	.88	.85	.88
AVLA	.96	.92	.85	.92	.91
AVSA	.88	.92	.81	.88	.88
AVP	.92	.88	.83	.91	.88
$\bar{X}$	.92	.88	.83	.91	

TABLE 3

ANALYSIS OF VARIANCE FOR CUEING METHODS AND DRAWINGS FOR FOURTH GRADE Ss

Source	df	ss	ms	F	p
Between Subjects	103	10.440	0.101	0.000	
D x C	3	0.200	0.066	0.650	.585
Error	100	10.240	0.102	0.000	
Within Subjects	312	31.250	0.100	0.000	
Drawings	3	0.584	0.195	1.940	.123
Cueing Method	3	0.103	0.034	0.343	.794
D x C	6	0.457	0.076	0.758	.603
Error	300	30.106	0.100	0.000	
Total	415	41.690	0.100	0.000	

*p< .05
**p< .01

D = Drawings. C = Cueing Methods

The analyses for the first grade scores revealed significant main effects for both cueing methods and drawings. A significant interaction of cueing methods and drawings was also noted. The results of these analyses are shown in Tables 4 and 5.

TABLE 4

MEAN TREATMENT SCORES FOR FIRST GRADE Ss

Cueing Methods	Fruit	Dog	Fish	Bird	$\bar{X}$
AV	.88	.38	.34	.25	.46
AVLA	1.00	.38	.19	.81	.59
AVSA	.88	.44	.47	.53	.58
AVP	.78	.69	.50	.84	.70
$\bar{X}$	.88	.47	.38	.61	

TABLE 5

ANALYSIS OF VARIANCE FOR CUEING METHODS AND DRAWINGS FOR FIRST GRADE Ss

Source	df	ss	ms	F	p
Between Subjects	127.	34.139	0.269	0.000	
D x C	3.	5.881	1.960	8.602**	.001
Error	124.	28.258	0.228	0.000	
Within Subjects	384.	90.250	0.235	0.000	
Drawings	3.	18.803	6.268	35.823**	.001
Cueing Methods	3.	3.771	1.257	7.185**	.001
D x C	6.	2.590	0.432	2.467*	.024
Error	372.	65.086	0.175	0.000	
Total	511.	124.389	0.243	0.000	

*p< .05
**p< .01

D = Drawings. C = Cueing Methods

The null hypothesis of no significant difference in Ss ability to extract relevant information from line drawings whether cued by orienting arrows, a pointer, or given no visual orienting cue, was rejected at the .05 level as shown in Table 6.

The null hypothesis of no significant difference in Ss ability to extract relevant information from line drawings containing orienting arrows as compared to line drawings containing no visual orienting cue, was rejected at the .05 level as shown in Table 6.

The null hypothesis of no significant effect of size of arrow on Ss ability to extract relevant information from line drawings, failed to be rejected at the .05 level as shown in Table 6.

The null hypothesis of no significant difference is Ss abi[illegible] to extract relevant information from line drawings when a point[illegible] used to direct attention as compared to line drawings when no v[illegible] orienting cue is used, was rejected at the .05 level as shown in Table 6.

The final null hypothesis of no significant difference in Ss' ability to extract relevant information from line drawings containing orienting arrows and from line drawings when a pointer is used to direct attention, was rejected at the .05 level as shown in Table 6.

A rank ordering of the comparative effectiveness of the cueing methods was determined. A comparison of the relative effectivness of the four cueing methods is shown in Table 6.

TABLE 6

TESTS OF DIFFERENCES OF MEANS FOR CUEING METHODS

		AV	AVSA	AVLA	AVP
		.46	.58	.59	.70
AV	.46	0	.12*	.13*	.24*
AVSA	.58		0	.01	.12*
AVLA	.59			0	.11*
AVP	.70				0

*$p \leq .05$
Difference (d) required for significance = .1035

Drawings

Significant differences in the mean scores of some of the drawings were attained at the .05 level using the difference of means test. The significant differences suggested that an ordering of the drawings by their relative difficulty for the Ss was possible. The significant differences in the mean scores of the drawings (lowest mean = highest difficulty) are shown in Table 7.

The drawings of the fish and dog were not significantly different in difficulty for the Ss. The drawing of the bird was significantly less difficult than the dog and fish drawings, while the fruit drawing was significantly less difficult than the bird drawing. These differences suggested a possible rank ordering of difficulty of drawings as shown in Table 7.

TABLE 7

TESTS OF DIFFERENCES OF MEANS FOR DRAWINGS FOR FIRST GRADE Ss

		Fish	Dog	Bird	Fruit
		.38	.47	.61	.88
Fish	.38	0	.09	.23*	.50*
Dog	.47		0	.13*	.41*
Bird	.61			0	.27*
Fruit	.88				0

*$p \leq .05$
Difference (d) required for significance = .1035

Interaction of Cueing Methods and Drawings

An attempt was made to discover a possible source or sources of the interaction of main effects. An examination of the simple effects of the cueing methods and drawings revealed a wide variation of means between the fruit drawing and the other three drawings. Although other interactions between specific cueing methods and specific drawings were observed, the extreme difference in means of the fruit drawing from the general trend of the other three drawings appeared to be the most likely source of the main effects interaction. A comparison of the variation of means for cueing methods and drawings is shown in Figure 3.

Summary

Results of the analysis of scores for fourth grade Ss showed no significant effects for cueing methods or for drawings. Ss did well on all drawings. At the first grade level significant effects for both cueing methods and drawings were found. The null hypothesis of no significant differences in Ss ability to extract relevant information from line drawings whether cued by orienting arrows, a pointer, or given no visual orienting cue, was rejected at the .05 level. No significant difference was found between the effectiveness of the two sizes of arrows. A rank ordering of cueing methods by effectiveness was established. The significantly different treatments (least effective to most effective) were: auditory cueing alone (AV), cueing arrows (AVSA/AVLA), and pointer (AVP).

A rank ordering of the difficulty of the drawings was also evident. The ordering in three levels of difficulty (least difficult to most difficult) was: fruit, bird, dog, and fish. An examination of the different means for cueing methods and drawings showed the fruit drawing as being significantly easier than the other drawings, and a possible source of cueing method by drawing interaction.

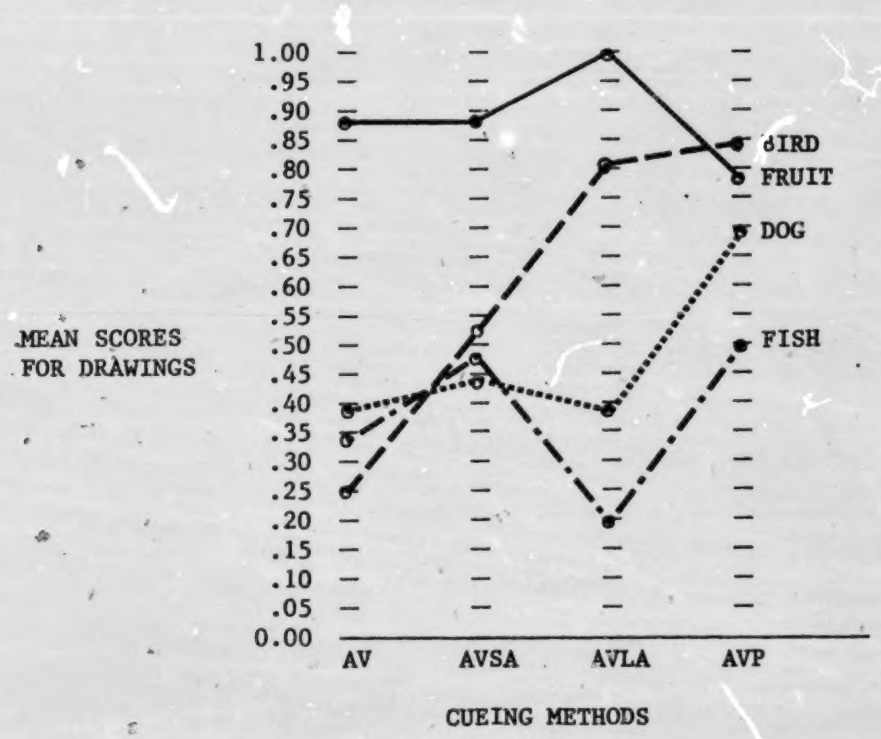

Figure 3. Comparison of the Variations of Means for Cueing Method for Individual Drawings for First Grade.

DISCUSSION

Fourth Grade Performance

Test results indicated no significant differences between cueing methods or between the drawings used. The probabilities associated with the F-values for cueing methods ($p < .79$) and drawings ($p < .12$) were not significant. Consequently, all null hypotheses were accepted ($\alpha < .05$) for this grade level. Examination of the means of the scores showed no mean below 83% on the criterion test. The consistently high mean scores indicated a high level of task proficiency by the fourth grade Ss.

Ss at this grade level were able to understand and process the auditory instructions for effective completion of the response tasks. The addition of visual cues did not appear to influence the Ss in the completion of the response tasks.

First Grade Performance

Differences between cueing methods were statistically significant for this grade level. All three visual cueing methods were statistically more effective than the auditory cues alone in aiding Ss to locate and mark specified portions of drawings. The mean score for the auditory cueing method for the four drawings was 46%, i.e., the auditory cueing method was the least effective method for helping Ss identify the correct drawing and to locate and mark the cued part.

It was noted that the auditory cueing method was effective for the response task on the fruit drawing at the first grade level. The first graders receiving this treatment did almost as well (88%) as the fourth graders receiving the same treatment (92%). Ss at both grade levels were probably very familiar with the content of this set of drawings and were able to perform well on the criterion task. Both "pear" and "leaf" were probably meaningful concepts which lessened the task difficulty of finding and marking the leaf on the pear for both grade-level Ss. The results further implied that the auditory cues given with the fruit drawings were appropriate and sufficient to elicit a high level of task performance for both grade levels for this particular drawing.

The Ss' ability to perform on the criterion task, when given only auditory cues, appears to be mainly a function of the variations in the clarity and adequateness of the auditory cues given and the Ss' familiarity of the content of the illustration. The first graders' success at this particular task may indicate that auditory cueing

alone may be sufficient for directing attention to specific information in a picture, if picture items are already familiar to them.

The first grade Ss receiving the auditory cueing alone did not perform as well on the drawings for dog, fish, and bird. These drawings and/or specific parts of the drawing were probably less familiar to the Ss than the fruit drawings. In any case, first grade Ss had more difficulty in locating and marking the cued parts on the drawings of the dogs, fish, and birds than they did on the drawing of the fruit.

Cueing by Arrows Versus Auditory Cueing Alone

Both sizes of cueing arrows were statistically more effective in helping the first grade Ss to locate and mark the correct parts of drawings. The mean score (.46) for the AV treatment and both treatment arrows, AVSA (.58) and AVLA (.59) were significantly different; ($p < .02$) and ($p < .01$) respectively. The addition of the cueing arrows to the auditory cues provided sufficient attention-directing information to significantly increase the Ss' success on the response tasks. The arrows were probably helpful to the Ss in completing the instructional tasks. The Ss were able to discriminate the arrows from the drawings and then perceive and utilize them as aids in locating the parts of the drawings auditorily cued. Perhaps it would be interesting to see if the cueing arrows would have been as effective if Ss had not received instructions on the use of arrows before the experiment. This author agrees with Kennedy (1971) that students frequently overlook, ignore, or incorrectly perceive cueing or signalling devices found in printed material or illustrations. This may be due to an author's or teacher's failure to communicate their intended meaning of cueing devices or methods used. For example, arrows have several different uses and meanings such as showing points of interest, intended direction or change in direction, and motion or movement of an object.

Comparison of the Two Sizes of Arrows

The results indicated that the smaller arrow (AVSA) was as adequate as the larger arrow (AVLA) for purposes of perception and use by the Ss to structure and remember the relevant task information. The difference of means test for the two sizes of arrows showed no significant differences in the arrows' effectiveness ($p < .85$). Both arrows were sufficiently different in line thickness from the drawings to be adequately perceived.

Although the two sizes of arrows used in this study did increase the Ss' ability to perform the response tasks, the mean scores for the two cueing arrows (AVSA = .58, AVLA = .59) showed there was much room for improvement of performance on the tasks for the dog, fish, and bird drawings. Further research comparing various styles and sizes of arrows with the same drawings, or using the same arrows with different drawings could possibly provide specific information pertaining to the use of arrows for directing students' attention to particular points of visualized instruction.

It is also possible that the auditory cueing information could be improved for the three sets of drawings on which the Ss did not do as well as they could have. Although the fourth grade Ss performed well with the same auditory information, it may have been either incomplete or too complicated for effective use by first graders.

Cueing by Pointer

The pointer proved to be the most effective visual attention-directing device used with first graders. The mean score for the AVP treatment (.70) was the highest mean score for any of the cueing methods. Significant differences were established between the AVP treatment and the AV, AVSA, and AVLA treatments. The greatest difference of means was observed between the AVP and AV cueing methods ($p < .001$). Smaller, but yet significant, differences of means were also noted between the AVP cueing method and the two cueing-arrow methods (AVSA = $p < .02$, AVLA = $p < .04$). The probabilities associated with the various comparisons of cueing methods are shown in Table 8.

TABLE 8

APPROXIMATE PROBABILITIES ASSOCIATED WITH T TESTS
FOR DIFFERENCES OF MEANS FOR CUEING METHODS
(INTERPRETATION OF TABLE 6 DATA)

Comparisons	t values	p
AV-AVSA	2.30	<.02
AV-AVLA	2.49	<.01
AV-AVP	4.59	<.01
AVSA-AVLA	0.19	<.85
AVSA-AVP	2.30	<.02
AVLA-AVP	2.10	<.04

One possible reason for the overall effectiveness of the AVP treatment was that the pointer presented a larger, impressive cue on the screen. The image of the sharpened No. 2 pencil on the screen was many times larger than the image of either arrow. There was very little chance of the Ss not seeing this cue as may have been possible with the arrows. Another factor is that pointers are probably the most common type of attention-directing device used by teachers. That students are accustomed to seeing their teachers use batons, rulers, and fingers as pointing devices to focus attention on important aspects of instruction cannot be overlooked as an important possibility accounting for the effectiveness of the pointer as an attention-directing device. A third possibility for the success of the AVP treatment was that some motion was also involved. The pointer was placed in the proper orientation by the experimenter while the Ss were viewing the drawings. The introduction of the placement motion may have served as an additional cue which helped direct the Ss' attention to the specified area of the drawing. Dwyer (1969), however, did not find motion to be an effective instructional cue. This does not rule out the possibility that motion was a cueing factor for the first grade Ss. Dwyer's Ss were college students.

Effects of the Drawings

Although no hypotheses were stated concerning the drawings used, the design was such that valuable information was gained which was useful to the experimenter in the assessment of the effectiveness of the various cueing methods.

No significant main effect was observed for drawings at the fourth grade level ($p < .12$). More visually complex graphic materials such as photographs, colored illustrations, and paintings might produce experimental variations in the effects of both cueing methods and graphic materials at this grade level.

A significant main effect was noted for the drawings at the first grade level ($p < .001$). The most prominent variation in the means of the drawings at the level was the high performance of the Ss on the task with the fruit drawings. This could probably be attributed to the Ss familiarity with the verbal and visual subject matter in this set of drawings. The Ss had more difficulty in correctly performing the criterion task on the bird drawing than on the fruit drawing. Auditory cueing was the least effective method for these drawings. Ss found it difficult to locate the tarsus of the flamingo with auditory cueing alone. The auditory cueing method alone was similarly effective for the bird, fish, and dog drawings.

Student task performance with the dog and fish drawings was the lowest. A possible explanation might be that the three fish and three dog drawings on the test pages were similar in design and familiarity, making discrimination of both the drawings on the page and the specified part more difficult for Ss. This would make it not only more difficult for Ss to locate the correct part initially, but also to recall it during the performance of the response task. These difficulties in correct orientation and recall could in turn cause the response marks to be more widely distributed over the response page.

Future Research

The study was limited to first and fourth grade subjects. Although this is a normal method of categorizing students, the students in class or grade level vary widely in skills and abilities. More useful information might have been acquired if the Ss were categorized not only by grade level, but also by classifications such as age, language development level, or diagnosed learning disabilities. A similar study dealing with mentally retarded or children with learning disabilities would be valuable for the development of materials and teaching techniques.

The auditory and visual characteristics of the stimulus materials needed to be better defined and controlled. The variety and range of characteristics of the auditory stimuli and drawings resulted in an excess of information which was difficult to isolate into specific units of analysis.

The benefits of other types of cueing devices such as color, circles, captions, and different sizes and styles of arrows were not examined in this study. The results of this study are not generalizable to the other types of cueing devices mentioned. Arrows colored differently than the drawings could provide useful information.

As the effects of a specific type of visual attention-directing device is isolated for a particular type of illustration this same device should be examined when used with other types of illustrations such as photographs, drawings, and paintings as shown in tests, workbooks and other visual materials used at different skill levels.

The criterion task of locating and marking a specified part of a drawing was a limiting factor in this study. This task involved relatively short-term memory. Other studies could be devised to provide information about the comparative effectiveness of cueing devices when used for other instructional objectives or tasks requiring longer memory spans such as an hour, day, or a week later.

Conclusions

It was concluded that the addition of visual attention-directing devices (arrows and pointer) to line drawings will not necessarily have any effect upon fourth graders' performance in locating and marking instructionally important parts of line drawings when clear, precise auditory cues are given.

The addition of visual attention-directing devices to line drawings can increase first grade students' performance in locating and responding to instructionally important parts of drawings even when clear, precise auditory cues are provided.

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